

be determined by taking the 4th root of the product of the scale factor, cubed, for the jth image of the 1st version of the document and the scale factor for the jth image of the 2nd version of the document as follows:

$$\sqrt[4]{s_1^3 s_2} \quad (4)$$

[0119] Discrete modifications to a document such as the addition or deletion of one or more images are independent of each other. Therefore, such modifications can be merged by executing each of the modifications.

[0120] Two different images can be added to a document simultaneously as each image addition is requested. If more than one request for the addition of the same image occurs, then one copy of the image can be added to the document. The position, rotation and scaling of the added image can be determined using the weighted mean (i.e., Equation (1)) as described above.

[0121] Modifications to document image parameters (i.e., position, rotation, and scale parameters) are typically highly context-sensitive (e.g. scaling up an image to make a page appear less empty). If a document image is moved to a different page, then that image will be positioned on the new page and all subsequent parameter changes to the image within the original document following the movement of the image are ignored. If several requests are made to move the same image to the same or a different page, a voting mechanism can be used to choose upon which page to place the image. In this instance, a weighted average of context-sensitive parameters can be determined from parameter modifications made on the elected page.

[0122] Modifications to a document can be notified to all collaborators as soon as the modifications have been requested. In this instance, network latency can be compensated for by estimating or predicting the result of other modification requests made by other collaborators. Alternatively, modifications to a document can be notified to collaborators upon the modifications being accepted.

[0123] Collaborators connected to a network can preferably request a digest of document modifications as the collaborators come on-line (i.e., become active collaborators) after being logged off for some period. Alternatively, notifications of document modifications can be e-mailed to collaborators. Such notifications can be transmitted individually or can be periodically packaged into a digest before transmission.

[0124] Document layout modifications can be automatically implemented by post-processing using a known least-squares fit method to satisfy a set of layout constraints. For example, objects of a document can be limited to a grid layout.

[0125] Returning to the method 100 of FIG. 1, if the processor 205 determines that a login request has been made in relation to a particular document (i.e., a LOGIN event is detected), at step 107, then execution proceeds to step 114. At step 114, the processor 205 transmits a login message over the network 220 to one or more of the collaborators, indicating that the sender of the message is logging into an editing session on the network 220, as will be described in more detail below with reference to FIG. 15, and then execution returns to step 101.

[0126] Further, in the method 100 of FIG. 1, if the processor 205 determines that a logout request has been

made in relation to a particular document (i.e., a LOGOUT event is detected), at step 107, then execution proceeds to step 116. At step 116, the processor 205 transmits a logout message over the network 220 to one or more of the collaborators, indicating that the sender of the message is logging out of an editing session for the document, as will be described in more detail below with reference to FIG. 20, and then execution returns to step 101.

[0127] FIG. 3 is a flow diagram showing the method 300 of processing the network message as executed at step 105 of the method 100. The method 300 is preferably implemented as software resident on the hard disk drive 210 and being controlled in its execution by the processor 205.

[0128] The method 300 begins at step 301 where the processor 205 detects the message and determines the content of the message. The message can be stored in memory 206.

[0129] If the message is a PUBLISH message (i.e., a PUBLISH event has occurred) then execution proceeds to step 304. The PUBLISH message indicates that the originator of the message is broadcasting a version of the document to the active collaborators as listed in the list of active collaborators configured within memory 206. As described above, the version of the document is indicated by the version string embedded within the document.

[0130] If the message is an ACK_DOC message (i.e., an ACK_DOC event has occurred), at step 301, then the method 300 proceeds to step 308. The ACK_DOC message indicates that the originator of the message is acknowledging receipt of a version of the document.

[0131] If the message is a LOGOUT message (i.e., a LOGOUT event has occurred), at step 301, then execution proceeds to step 314. The LOGOUT message indicates that the originator of the message is logging out of an editing session for the document on the network 220.

[0132] If the message is a LOGIN message (i.e., a LOGIN event), at step 301, then the method 300 proceeds to step 316. The LOGIN message indicates to all active collaborators (i.e., those collaborators currently on-line) that the originator of the message is logging into an editing session on the network 220.

[0133] If the message is a MODIFY message (i.e., a MODIFY event), at step 301, then execution proceeds to step 320. The MODIFY message indicates to all active collaborators that the originator of the message is transmitting a patch (i.e., a representation of a modification to the document) for the document. The patch is transmitted together with the MODIFY message.

[0134] If the message is an ACK_LOGIN message (i.e., an ACK_LOGIN event), at step 301, then the method 300 proceeds to step 328. The ACK_LOGIN message indicates to the recipient of the message that the originator of the message is acknowledging the recipient's logging in to an editing session for a particular document.

[0135] If the message is an ACK_MOD message (i.e., an ACK_MOD event), at step 301, then execution proceeds to step 336. The ACK_MOD message indicates to the recipient that the originator is acknowledging receipt of a patch that the recipient has sent to the originator of the message.